

Preliminary Data on the Anatomy of the Genital Systems in *Craterostigma tasmanianus* (Craterostigmomorpha) and *Esastigmatobius longitarsis* (Henicopidae, Lithobiomorpha) (Chilopoda)

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ABSTRACT

Microanatomical studies on the genital system of *Esastigmatobius longitarsis* and *Craterostigma tasmanianus* provide arguments to establish phyletic relationships between Henicopidae and Lithobiidae, and on the other hand between Craterostigmomorpha, Lithobiomorpha and epimorphic chilopods. Microanatomical studies on adult males of *Craterostigma tasmanianus* indicate the presence of paired testes connected by the efferent canals to a single median deferens canal. The male genital system of *C. tasmanianus* is similar to that of the orders Scolopendromorpha and Geophilomorpha. The male genital system in *Esastigmatobius longitarsis* presents a single flagelliform median testis and two seminal vesicles. The testis is continued by a deferens canal which opens in the zone of the confluence of the two seminal vesicles. The genital tract is continued by two ejaculatory ducts, which open separately into the atrium. The glandular system of the male genital tract is composed of dorsal accessory glands, ventral accessory glands and atrial glands. In the single testis there is a unique type of spermatogenesis producing spermatocytes of large size. The female genital system, similar to that of Lithobiidae, is also described. The possible phyletic relationships of the family Henicopidae *s. st.* and the tribe Anopsobiini are discussed.

RÉSUMÉ

Données préliminaires sur l'anatomie du système génital mâle chez *Craterostigma tasmanianus* (Craterostigmomorpha) et des systèmes génitaux mâle et femelle chez *Esastigmatobius longitarsis* (Henicopidae, Lithobiomorpha) (Chilopoda).

Des études d'anatomie, en microscopie optique, des individus mâles de *C. tasmanianus* indiquent la présence de paires de vésicules testiculaires reliées par des canaux afférents à un canal déférent central, impair. Le système génital mâle de *Craterostigma* est similaire au système génital des ordres Scolopendromorpha et Geophilomorpha. Le système génital mâle chez *Esastigmatobius longitarsis* présente un seul testicule médian, flagelliforme et deux vésicules séminales. Le testicule est prolongé par un canal déférent allongé et contourné qui débouche dans la zone de confluence des vésicules séminales. Le système glandulaire du tractus génital mâle est formé de glandes accessoires dorsales, accessoires ventrales et atriales. Dans le testicule se déroule un type de spermatogenèse unique avec des spermatocytes de grande taille. On décrit aussi le système génital femelle de cette espèce qui est semblable au système génital femelle des Lithobiidae. La discussion finale concerne les relations phylogénétiques de la famille Henicopidae *s. str.* et de la tribu Anopsobiini.

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INTRODUCTION

Genital systems are relatively well studied within the family Lithobiidae (cf. ATTEMS, 1926; PRUNESCU, 1964, 1965a; RILLING, 1968; LEWIS, 1981).

Many years after the description of the microanatomy of the female genital system in *Craterostigma tasmanianus* was published (PRUNESCU, 1965b), we obtained new specimens of this species. Difficulties in fixing and preserving of this material as well as a disadvantageous sex ratio of this lot have not allowed us to make good quality dissections capable of clearing up the problem of the precise number of pseudometameric testicular vesicles. Taking into account that any positive data, even incomplete, dealing with the order Craterostigmomorpha are opportune and can be useful in this period of cladistic phylogeny, we propose the preliminary data presently at our disposal.

In the family Henicopidae, which presents an extra European distribution, the genital system in general does not yet seem to have been studied. We present microanatomical data on the genital system in *Esastigmatobius longitarsis*, as they appear from the study of the serial cross-sections of the posterior half of the body, in male and female individuals.

MATERIAL AND METHODS

Several individuals of *C. tasmanianus* were collected from Goderich Road (N.W. Tasmania) by R. MESIBOV at an altitude of 580 m, on 12 September, 1991. They were fixed in 3% glutaraldehyde, in cacodylat buffer, pH 7.4, for 4 days. The parts were then placed in 70% ethylic alcohol. After routine histological technique, paraffin-embedded material was sectioned at 6 μ m and coloured with hemalum-eosine. Some adult male and female individuals of *E. longitarsis*, collected from Japan by K. SHINOHARA and fixed in 70% ethylic alcohol were studied using the same methods.

RESULTS

Genital system of Craterostigma tasmanianus

The testicular system of *Craterostigma tasmanianus* consists of several testicular vesicles placed one side and another of a deferens duct (Figs 1-4). Each testicular vesicle is an elongated and sinuous formation. It communicates with the central deferens duct by two other afferens ducts, one anterior and the other posterior.

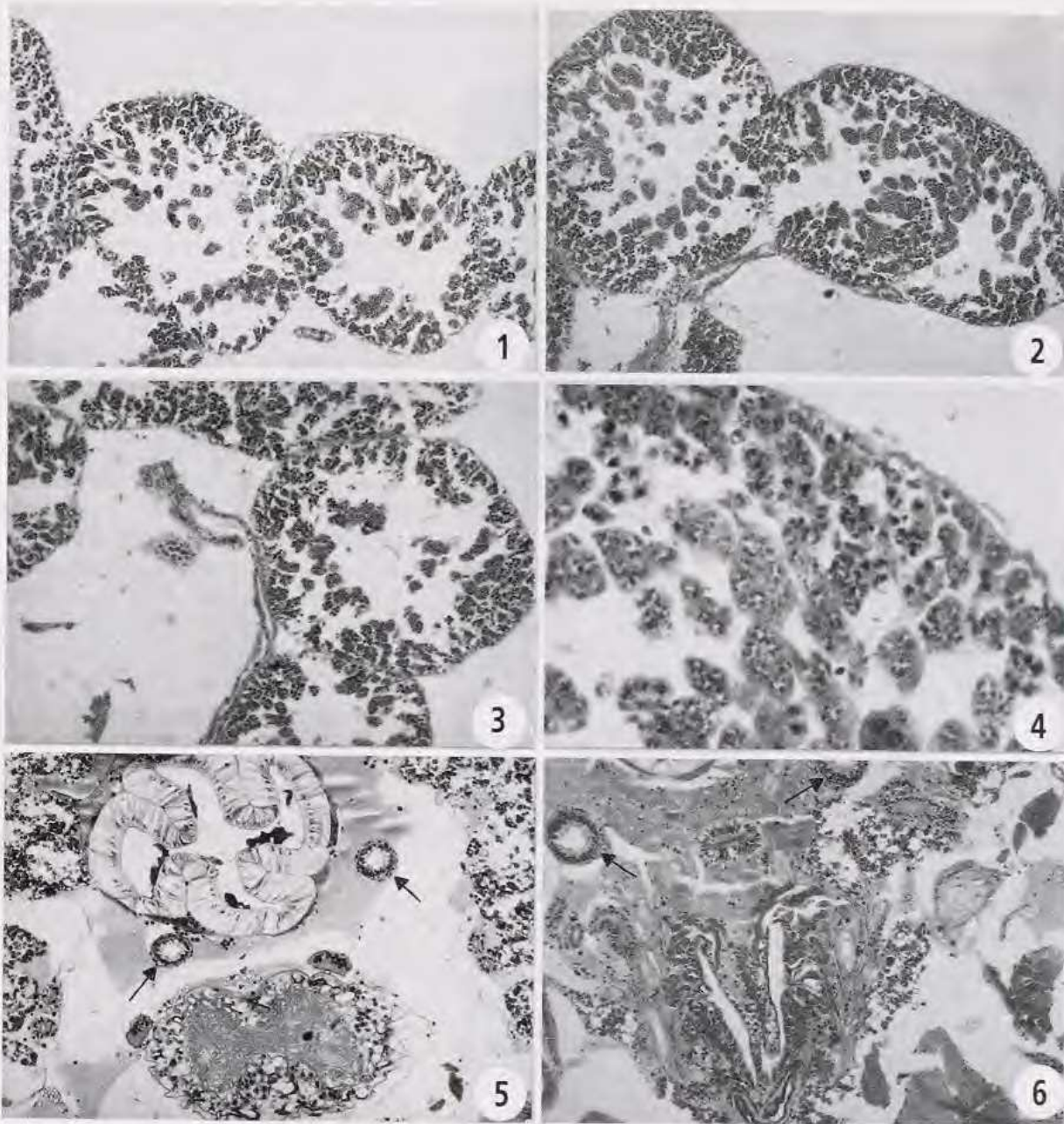
The deferens duct is bifurcated, in the hind-gut area, into two ejaculatory ducts (Figs 5-6) which descend to the ventral region of the body and open into the male genital atrium. The two ducts of the dorsal accessory glands also open here. The two ducts of the ventral accessory glands open into an unpaired ventral duct, which in turn communicates with the genital atrium (Fig. 6). Both dorsal and ventral accessory glands are well-developed acinous glands.

Male genital system of Esastigmatobius longitarsis

The testis is unpaired, tubular and elongated (Fig. 7). Towards the posterior end, the lumen of the testis narrows and takes on the aspect of a deferens duct (Fig. 8). In its caudal part, the deferens duct holds numerous spermatogonia and even small spermatozoa. These spermatozoa occur in different stages of cellular degeneration.

On the left and right sides of the testicle, there are elongated, tubular, seminal vesicles, situated dorsally relative to the medium intestine and closed at their anterior end like a glove finger. The two seminal vesicles join and immediately after their joining, in the medio-dorsal part of the resulting formation, the deferens duct of the testis opens (Fig. 9).

The genital tractus is continued by two ejaculatory ducts (Fig. 10) which descend by the posterior intestine. In their anterior part, the ejaculatory ducts are represented by two large, dilated tubes with thick walls consisting of a secretory cylindrical epithelium. This epithelium synthesizes and secretes into the lumen a finely granulated eosinophil-rich secretion, mixed with numerous basophil granules. As these ducts descend in the ventral and caudal part of the body, their diameter grows smaller and the lumen narrows.



FIGS 1-3. — Sections through the testicular vesicles at the deferens canal level. Note the efferens canals and the deferens canal. x120.

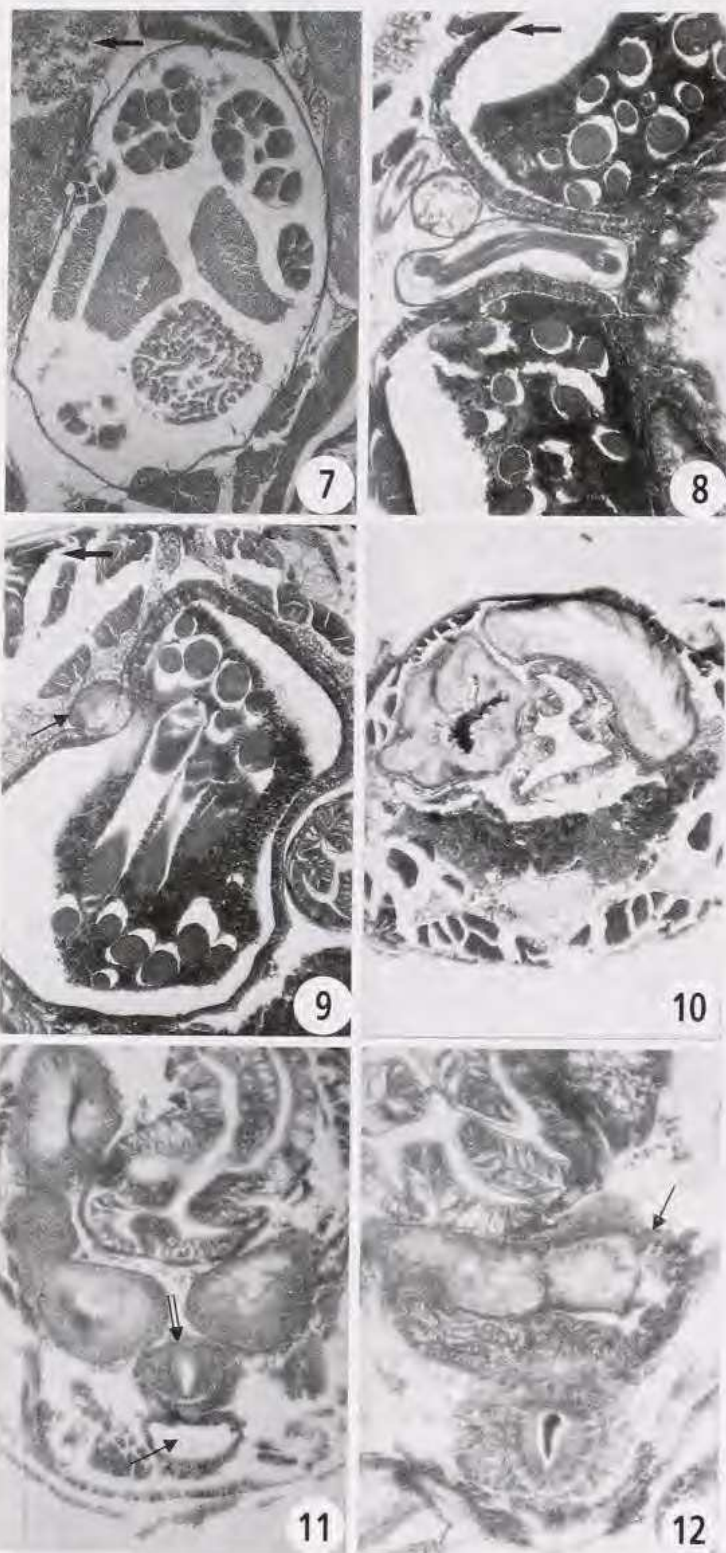
FIG. 4. — Testicular vesicle (detail). Spermatogonia and spermatocytes are seen during the division process or at the beginning of the growth. x500.

FIG. 5. — Transverse section through the hind-gut region. The two ejaculatory canals (arrowed) can be seen between the hind-gut and a ventral nerve ganglion. x120.

FIG. 6. — Section through the male genital atrium. Ejaculatory canals (arrow). x160.

The single pair of dorsal accessory glands and the single pair of ventral accessory glands are acinous tubular glands. The ducts of the ventral accessory glands join (anteriorly) to form an unique duct which represents part of the genital atrium (Fig. 11). The ducts of the dorsal accessory gland also join, posteriorly, to form a single duct. It is continued by a cylindrical

structure which represents the central part of the genital atrium, also named the central duct of the atrium (Fig. 11).



The two ejaculatory ducts penetrate separately into a dorsal structure of the genital atrium (Fig. 12). The bottom of this structure consists of a glandular epithelium. The ejaculatory ducts open in the atrium caudally, after the central and the unique ducts of the ventral accessory glands join and open outwards. In the atrium, an acinous atrial gland forms caudally (Fig. 13).

FIG. 7. — Transverse section through the single testes; it presents many groups of spermatocytes and fascicles of spermatozoa. x100. The thick arrow shows the top of the slide.

FIG. 8. — Transverse section through posterior extremity of seminal vesicles. Within these vesicles can be seen fascicles of spermatozoa and a granular secretory material. Between the seminal vesicles, many profiles of the deferens duct are visible. x90. The thick arrow shows the top of the slide.

FIG. 9. — Transverse section at the level of the joining of the two seminal vesicles; the deferens duct can be seen dorsally and the hind-gut ventrally. x 90. The thick arrow shows the top of the slide.

FIG. 10. — Transverse section at the level of the ejaculatory ducts. x60.

FIG. 11. — Transverse section through the ejaculatory ducts at the level of the genital atrium. Single arrow indicates the unique duct of the ventral accessory glands; double arrow the central duct of the atrium. x90.

FIG. 12. — Genital atrium at the level of the opening of the ejaculatory ducts (arrow). x140.

Female genital system of Esastigmatobius longitarsis

The female genital system consists of an elongated tubular ovary which is above or beside the mid-gut (Fig. 14). The caudal part of the ovary is continued by two oviducts which descend and surround the posterior intestine. A pair of large seminal receptacles (Fig. 15) communicates with the genital atrium by a narrow duct. It is surrounded by a sheath of circular muscles. The genital atrium is a large structure which presents, in its anterior part, a high epithelium surrounded by numerous glandular acini, the ducts of which open into the atrium (Fig. 16). In cross-section, the female genital atrium presents a V-shape. Each oviduct opens into the corresponding latero-dorsal end (Fig. 16). The ducts of ventral glands open separately through the latero-ventral walls of the atrium (Fig. 17). The ducts of the seminal receptacles wind several times in tight spirals, penetrate the dorsal wall of the atrium, and open into the terminal part of the atrium (Fig. 18). The dorsal accessory glands open at about the same level, through the latero-dorsal walls of the atrium.

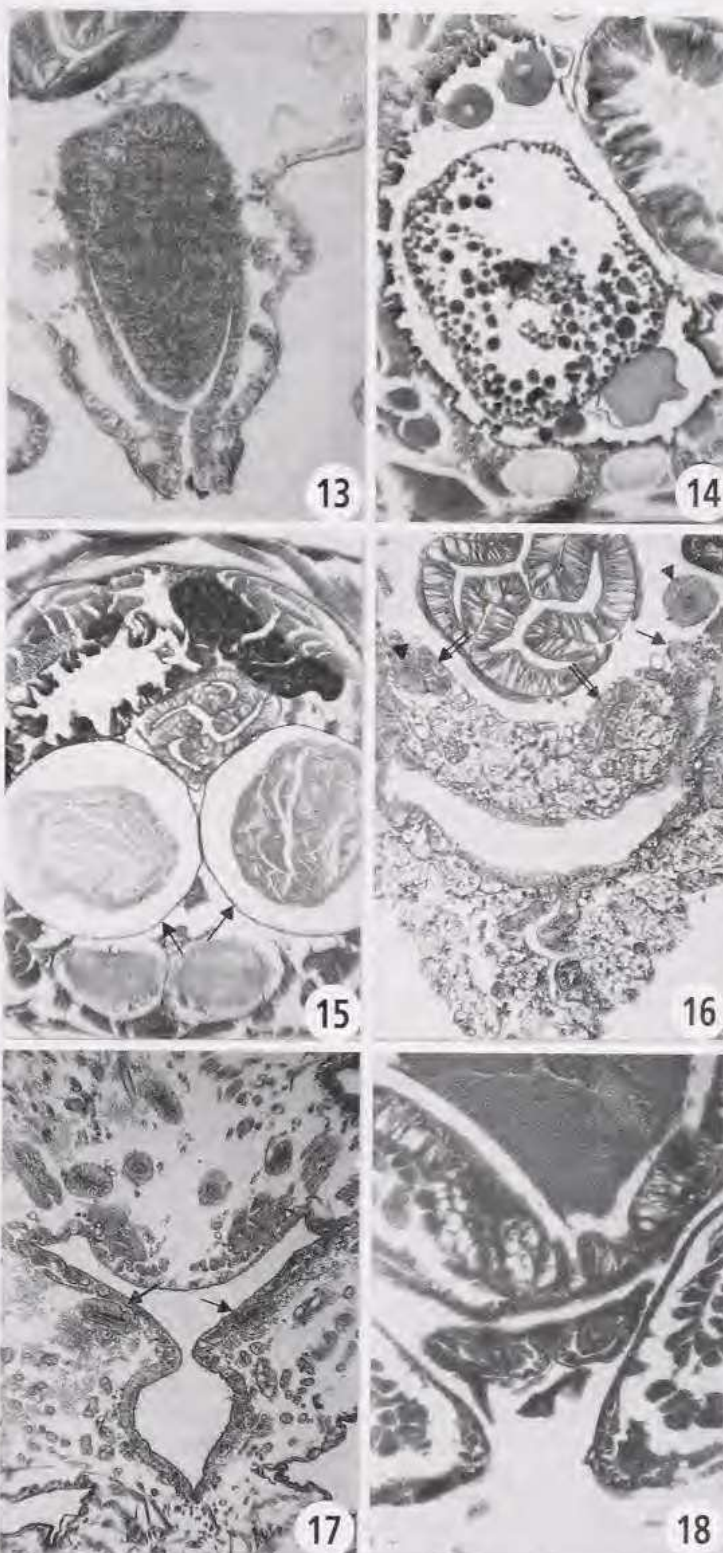


FIG. 13. — Acinous atrial gland. x140.

FIG. 14. — Transverse section through the ovary. x100.

FIG. 15. — Transverse section through the seminal receptacles (arrow). Inside of the receptacles are masses of spermatozoa. x60.

FIG. 16. — Transverse section through the anterior region of the genital atrium at the level of the opening of the oviducts. Arrow indicates oviduct, the arrowheads the ducts of the seminal receptacles, the double arrow the ducts of the accessory dorsal glands. x90.

FIG. 17. — Opening of the ducts of the ventral accessory glands (arrow). x90.

FIG. 18. — The terminal zone of the genital atrium. Opening of the ducts of the semi-receptacles. x200.

DISCUSSION

Our data on the testicular system of *Craterostigmus tasmanianus* do not allow us to specify the number of the vesicular testicles. That seems to be equal to or larger than two pairs. The testicular system in *C. tasmanianus* resembles that of epimorphic chilopods. We have to mention the missing of the seminal vesicles, characteristic for Lithobiomorpha. The fact that the larva of *C. tasmanianus* has 12 leg-bearing segments at its eclosion (MANTON, 1965) shows that this line detached from the main evolutionary line which linked anamorphic chilopods to epimorphic ones. It is known that *Craterostigmus* females take care of their eggs (LEWIS, 1981) as do all epimorphic chilopods. The presence of pseudometameric testes in a chilopod with 15 leg-bearing segments and many resemblances in its outer morphology and way of life with the epimorphic chilopods with an elongated body may have appeared and evolved from ancestors with anamorphic features (PRUNESCU, 1969a).

The male genital system of *E. longitarsis* resembles that of Lithobiidae. Unlike the Lithobiidae, whose ejaculatory ducts join before opening in the atrium by a unique ejaculatory duct, those of Henicopidae have the ejaculatory ducts opening separately into the genital atrium. The presence of paired male genital tracts in some genera of Anopsobiini (Henicopidae) (PRUNESCU & JOHNS, 1969; PRUNESCU, 1992a), indicates the phyletic complexity of Henicopidae and supports the idea that they have retained numerous plesiomorphic features of the genital system. The existence of a male gonopod of 4 articles in all lines of Henicopidae also argues for the primitiveness of this group but, at the same time, covers its heterogeneity. The presence in the deferens duct of the single testicle of small elements belonging to an abortive spermatogenesis, suggests a closeness of this phenomenon to the microspermatogenesis in the deferens duct-microtestes in *Scutigera* (FAHLANDER, 1938; PRUNESCU, 1969b, 1992b) and Anopsobiidae (PRUNESCU & JOHNS, 1969). The female genital system presents less significant morphological differences in comparison with that of in Lithobiidae.

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